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On the Life History of *Bhutanitis lidderdalei* ATKINSON in Bhutan (Lepidoptera, Papilionidae)

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Preface

Dr. R. LIDDERDALE was responsible for the discovery of *Bhutanitis lidderdale* ATKINSON (Rhopalocera, Papilionidae) in 1868 near Buxa (alt.: 6,000ft), Bhutan. This multicoloured large butterfly with an impressive wing form soon became the target of study by a number of lepidopterists, who tried to find out its relation with other groups of swallowtails. Many reports on its habits and distribution have been published, but none refers to its early stages apparently because of the difficult approach to its habitats which are confined to remote mountains of considerable height. During the past 118 years, the only reference to an early stage of this species was made by TYTLER (1912), who wrote out a report to the effect that two females collected on the Naga Hills laid eggs, which were described as yellow in colour and rather small for the size of the butterfly.

The present author visited Bhutan in 1986 and 1987, and was fortunately able to observe other stages of its life history, described and illustrated in this article.

I obtained eggs of *Bhutanitis lidderdalei* in captivity in the autumn of 1986. Earlier, in the spring of 1985, LEE (1986a, b) succeeded in rearing *Bhutanitis thaidina* BLANCHARD and *Bhutanitis mansfieldi* RILEY. Thus, the life histories of three out of the four known *Bhutanitis* species have been elucidated. LEE's contribution to the study of phylogeny of the Papilionidae should be highly evaluated.

In writing this article, the author is indebted to Dr. Takashi SHIRÔZU, Honorary President of the Lepidopterological Society of Japan (LSJ), Dr. Masami OGATA, President of LSJ, Dr. Yoshihiko KUROSAWA of LSJ, Prof. Toshitaka HIDAKA of Kyoto University, Prof. Shigeru A. AE of Nanzan University, Prof. Toyohei SAIGUSA of Kyushu University, Mr. T. G. HOWARTH and Mr. C. G. C. DICKSON, for their advice and suggestions ; to the late Emeritus Prof. Hiroshi HARA of Tokyo University and Dr. Yukiko KUROSAWA of Tokyo University, for the identification of plant specimens.

In the field, the author had the valuable assistance of Messrs. Motohiro HARADA, Hirotaka MATSUKA, Yoshiaki GUNJI, Keiichi HARA and Akira YOKOKURA ; he was also given useful information by Mr. Kaiya KUBO and Mr. Seiichi KASHIWABARA. The author's wife Yoshiko took part in field work, and her contributions are also worthy of mention.

Life History

1. Distribution and habitats

B. lidderbalei is distributed in Bhutan, Nothern India (Chin Hills and Naga Hills), Burma, Thailand and Western China. In every region it seems to be local, being confined to narrow regions whose altitudes centre around 2, 000 metres above sea level. In the neighbourhood of Chasilakha, Western Bhutan, the butterflies were seen on the wing only along a road section of about two kilometres. Since the road had been cut on an almost vertical wooded mountainside, there was no knowing how high and low the habitat extended. There, the dense evergreen flora included the butterfly's food-plant (*Aristolochia*). Outside this short section the butterflies drastically decreased in number.

2. Adults' habits

Both males and females are more active on cloudy days than on fine days. They did not seem to mind even rainy weather. They fly slowly above tree tops, often near the road. Most of the high fliers are males, while females are seen on much lower levels. The butterfly, either male or female, only flutters the fore wings, with the hind wings hardly moved. This is suggestive of the flight of a *Byasa* species. During an uninterrupted flight, it repeats regular ups and downs. When one butterfly leaves its perch and starts flying, other sitting butterflies follow suit, as if in unison. Males as well as females are attracted to spikes of whitish flowers, such as those of Umbelliferae and Polygonaceae. There are reports on adults in Northern Thailand taking moisture, but in Bhutan no individual was seen drinking from a road puddle.

The adults are usually seen on the wing from 10 a.m. to around 5 p.m., a single individual still flying even towards 6 p.m. They seem to favour rather a narrow optimal temperature range centring around 20℃ for their activity. Temperatures lower than 16℃ appear to inhibit their flight.

DOHERTY (1891) says a flying individual of *B. lidderdalei* resembles *Parantica sita*. This is particularly so when the flight season is nearing its end, as the wings of surviving individuals are discoloured. In addition, they both have an up-and-down flight habit, making the distinction from a distance quite difficult. DOHERTY also likened its flight to that of *Hestia* (=*Idea*) species, but none of the latter was seen in that particular habitat in Bhutan. He says freshly killed specimens gave off a fragrant odour for several days, but the present author failed to smell anything of the kind.

3. Number of broods

In the neighbourhood of Chasilakha, Western Bhutan, male butterflies begin to emerge towards the end of August, becoming abundant in early September. Females appear in mid September, and probably start laying eggs in late September. Courting males and the ovipository behaviour of females are still observable at the beginning of October, so that the adult is probably on the wing until around mid October (Fig. 1).
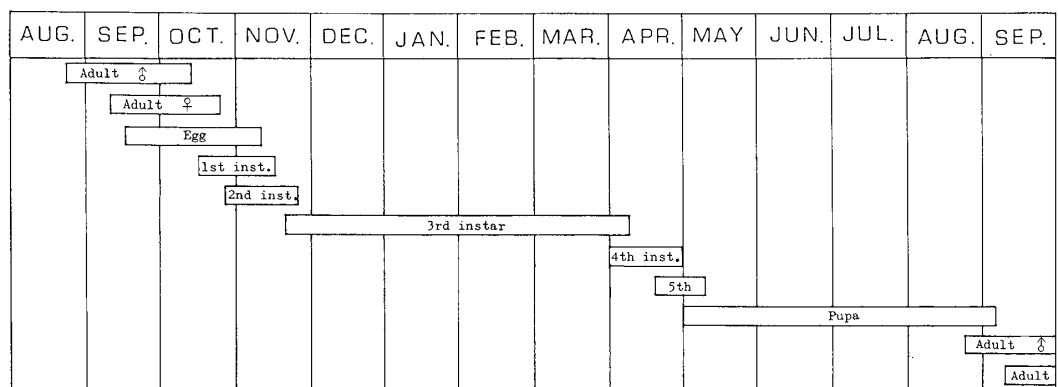
Fig. 1. Inferred seasonal life-cycle of *Bhutanitis lidderdalei*.

Since there are no record of spring or early summer butterflies being spotted or caught, and according to the personal experience of the author, the butterfly is considered to be univoltine and confined to autumn. The situation is exactly the same in the Naga Hills, India, and Chiang Dao in Northern Thailand.

4. Courtship

The author observed on several occasions between mid September and early October 1986 a pair of butterflies falling together from the canopy to the ground. First he took them to be *in copula*, but the butterflies parted on reaching the ground and flew away. Observation of more such pairs showed that they had not been actually copulating, but that the males had only straddled the females. It was evident that the females had refused to pair from the start, while the courting males stuck to them in their vain effort to mate, thus falling together to the ground. The author has never seen such behaviour so frequently in any other species of butterflies. Unfortunately he has not observed a normal process of courtship culminating in copulation.

5. Copulation

One mating couple in flight was observed in September, 1985, which looked no different from an average *papilionid* species. The female carried the hanging male.

6. Forced oviposition

Four females caught in mid September, 1985, were brought to Phuntsoling (alt.: 400m) for egg-laying in captivity. Each female was kept in a plastic bag, in which *Aristolochia griffithii* (Fig 2 : it was not known then that the plant was no other than local foodplant of this butterfly) was provided. The bags were kept indoors, where the temperature ranged between 26℃ and 29℃. The lighting conditions varied : one bag was in contact with a 40-Watt fluorescent lamp, others receiving light from a 60-Watt incandescent lamp about 3m away.

The females soon showed interest in the enclosed plant and started laying eggs. In each case, the female held on to the edge of a leaf, bent its abdomen in a U-shaped and felt the underside of the leaf with its extremity of the abdomen (papillae anales) before

laying an egg. One egg was laid in about 20 sec. A batch of 20 to 40 eggs was laid at a time. If the tip of the abdomen touches a laid egg, the butterfly moves it around before it laid another egg. When engaged in laying, the butterfly was not distracted from the act by light touches.

The egg batches obtained in this way were taken to Japan on September 25th, but not a single egg hatched after all. It was thought that Phuntsoling had been too warm and that the ova had been infected with some fungi.

Exactly one year later, five females were similarly treated and they produced a number of eggs. This time, the leaves with egg batches were kept in a cloth bag and hung in shade at Chasilakha (alt.: 1, 990m), where the mother butterflies had been caught. This brought about more or less satisfactory results and many eggs hatched.

7. Ovipositing behaviour

Although no wild female was spotted in the act of laying eggs, several ones were seen apparently looking for an ovipositing place between late September and early October 1986.

The female approaches the larval foodplant and taps the surface of a leaf with its fore legs. As in the case of any species whose female lays a batch of ova at a time, *B. lidderdalei* seemed very particular about the choice of a leaf on which to deposit its eggs. Those females after all failed in finding a suitable leaf and flew away, and with good reason, as it turned out later. The discovery of ova laid in nature strongly suggested that those leaves tapped but rejected by the interested females were too exposed, being close to the road.

On September 30th, a batch of 18 eggs was found on the underside of a leaf of *Aristolochia griffithii* about 50 cm from the ground. The site was near the southern-most edge of the habitat inside an entirely sheltered undergrowth. A leaf on the same vine, but some 20 cm lower carried a batch of 36 eggs. A lower leaf of a different stock, 20 cm or so above the ground, had 10 ova. Then, on October 4th, when a search was made elsewhere in a similar environment, a batch of 41 eggs was found at only 15 cm above the ground. Thus it became clear that the females prefer quite low leaves in dark surroundings. Needless to say, searches of leaves at middle and great heights, or those in positions exposed to wind and sunshine, produced no eggs at all. This ovipositing habit conforms with those of other species of Zerynthiini.

8. Foodplants

Only *Aristolochia griffithii* (Fig. 2) was identified as a local foodplant in Bhutan. No other *Aristolochia* species have been found in the habitat. In capitivity in Japan, the larvae were given various plants of the genus available to the author. They readily accepted *A. kaempferi* (Japan), *A. mandshuriensis* (Korea) and *A. shimadai* (Taiwan), but refused to eat *A. debilis* (Japan), *A. contorta* (Korea) and *A. clematitis* (France).

The larvae of Zerynthiinii so far reared are known to feed on small-leaved, less hairy species of *Aristolochia* including *A. debilis*, but not on large-leaved, hairy ones like *A. kaempferi*. It is interesting to note that the larvae of the Chinese species *B.*
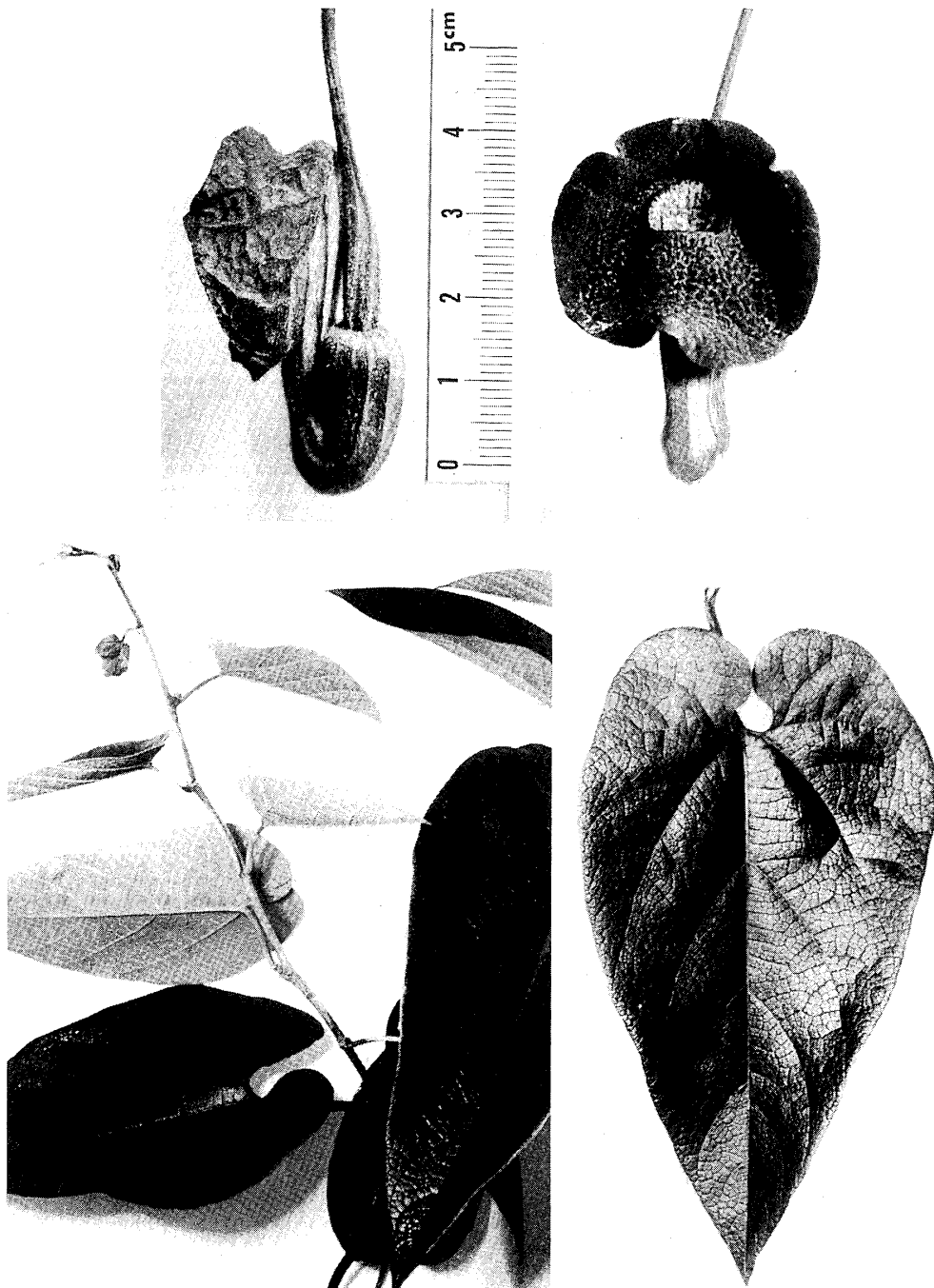
Fig. 2. *Aristolochia griffithii* (Aristolochiaceae), host plant of *Bhutanitis lidderdalei*.

thaidina feed on *A. moupinensis* (LEE, 1985), which also belongs to a large-leaved, hairy group of *Aristolochia*.

9. Early stages (Fig. 1)

Egg : the egg stage lasts for about a month. This is one of the longest cases, second only to *Parnassius* whose eggs overwinter and spend approximately ten months as such.

For instance, eggs laid in captivity on September 29th, 1986, (kept outdoors in the habitat until October 5th) hatched on November 2nd (kept at 19 to 20℃ indoors since arrival in Japan). The local climate after mid October is probably cooler than this temperature range, and the egg stage in the habitat is supposed to be more prolonged.

Larva : numerous larvae that hatched between mid October and mid November were reared under different conditions.

1) Those kept at temperatures 22 to 25℃ mostly perished by mid December.

2) A small number of larvae reared at lower temperatures (12℃ daytime, 6℃ at night) produced survivors : one pupated on February 27th, 1987 and another on April 4th. They were kept at 22℃ from May onwards. Adults were formed up in August but they failed to emerge.

3) Six larvae kept indoors under uncontrolled room temperature successfully pupated between late December 1986 and early January 1987. Three males emerged, one each on April 14th, May 4th and May 19th. The remaining three died in summer but one of them had formed up.

4) Most of the larvae kept outdoors stopped growing at the third instar, though the rest advanced to the fourth instar. The winter in the habitat in Bhutan is said to be quite cold, with frost coming in November, and snow in December. However, the larvae are probably not exposed to the rigour of winter, in view of the fact that the females lay eggs in low, sheltered positions in the forest. It may be safely concluded, therefore, that *B. lidderdalei* passes the winter as half-grown larvae in Bhutan.

The larvae hibernating in Japan kept to the underside of the leaf, feeding conservatively. They sit in twos or threes, or alone. Gregariousness did not appear to be of great importance during hibernation. The amount of food they consumed seemed just sufficient for subsistence, as their sizes did not change during the cold months.

The larvae proved to be quite hardy and survived the winter. *A. griffithii* is an evergreen vine, giving out fresh leaves in April. The larvae devoured them and pupated in early May. No immediate emergence of adults followed. The pupae were kept indoors and seemed formed up in August, but they died after all.

The univoltine emergence in autumn of this butterfly is no doubt determined by the larval hibernation.

The larvae are gregarious throughout their life, sitting side by side on the underside of the leaf. However, they tend to disperse into smaller groups as they grow older, and the last instar larva is either solitary or finds only one mate. While the mature larvae of *Pachliopta* and *Atrophaneura* like to feed leafstalks and stems, those of *B. lidderdalei* only care for the leaf.

Pupation takes the normal girdle position. The cage for pupation was provided with dead twigs and a bed of dead leaves, where the larvae pupated on the twigs within 30 cm from the bottom. LEE (1985) reports that *B. thaidina* pupated among the leaves, but that was not the case with *B. lidderdalei*. Search of wild pupae or their exuviae in Bhutan was without success.

Morphology

Egg : Dome-shaped, with very minute process on top ; bottom moderately concave ; orange at first but soon turning into pale yellow ; 1. 37 mm in diameter and 1. 07 mm in height.

First instar larva (Figs. 3 – 6) : Head glossy dark brown, 1.90 mm in width and with black setae ; head chaetotaxy the most primitive, as in other species of Zerynthiinii ; osmeterium short and yellowish orange ; prothoracic plate glossy dark brown, provided with seven pairs of long and short setae ; body dark purplish grey, with the dorsal line flanked by a grey line on either side from the prothorax to the 9th abdominal segment ; one low wart-like process on the subdorsal line on each segment from the mesothorax to the 9th abdominal segment, five orange (on mesothorax, 2nd, 3rd, 7th and 8th abdominal segments) and six white, each provided with along black seta on top ; one low white wart-like process on the subspiracular line on each segment from the prothorax to the 8th abdominal segment, with one or two black setae ; anal plate glossy dark brown, with seven pairs of black setae ; thoracic legs glossy dark brown, prolegs and anal legs dark purplish grey, being the same as the body colour.

Second instar larva : Head glossy dark brown, 1. 31. to 1. 44 mm in width, with black hairs ; processes on body much more prominent than in the previous instar ; processes and body the same in colour as before, but single seta on warts is colourless.

Third instar larva : Head 1. 97 to 2. 48 mm in width ; processes still more prominent than before, with the orange colouring more intense ; those on the subspiracular and basal lines well as assuming an orange hue.

Fourth instar larva : Head 2. 98 to 3. 20 mm in width ; processes more developed than in the 3rd instar ; those on the 2nd, 3rd, 7th and 8th abdominal segments pale yellow instead of orange.

Fifth (final) instar larva : Head 4. 70 mm in width ; body characters more or less the same as in the 4th instar ; the processes on the 2nd, 3rd, 7th and 8th abdominal segments no longer yellowish, being indistinguishable from the white ones on other segments ; in contrast, those on the basal line now rich orange.

Pupa (Fig. 7) : Body cylindrical, with the head and prothorax dorsally flat like a diagonal kerf ; brown in colour, with ubiquitous minute depressions making it camouflaging the base of a broken twig ; head with a pair of greyish white lobes ; prothorax with a pair of small processes and mesothorax with two pairs ; extremity of proboscis ending just short of the posterior end of the 4th abdominal segment ; fore legs exposed but mid legs partly concealed by the antennae ; thick white dorsal belt from the lst to 4th abdominal segments ; a pair of retrovert subdorsal processes on each segment from the 4th to 9th, except the 8th ; one trapezoidal area on the dorsum of each of the 5th and 6th abdominal segments between the subdorsal processes ; 7th abdominal segment dorsally white ; lateral and ventral areas white from the 8th abdominal segment to the caudal end ; 7th abdominal segment provided with a pair of conspicuous bifid ventral lobes ; girdle and caudal silk pad dark brown ; body length 34mm on average.
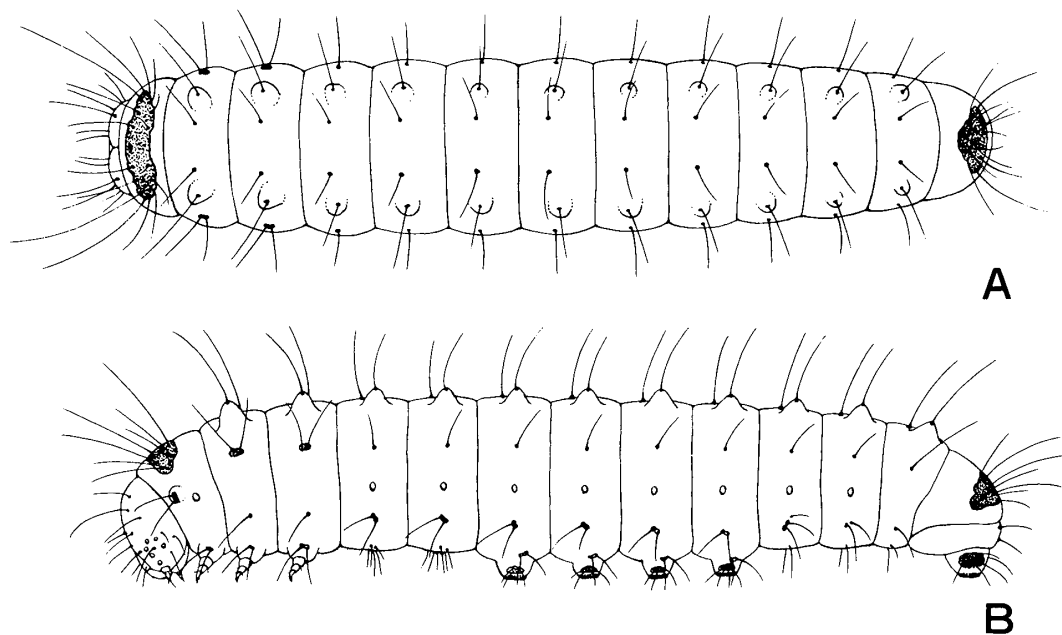
Fig. 3. First-instar larva of *Bhutanitis lidderdalei*. A. Dorsal aspect; B. Lateral aspect.
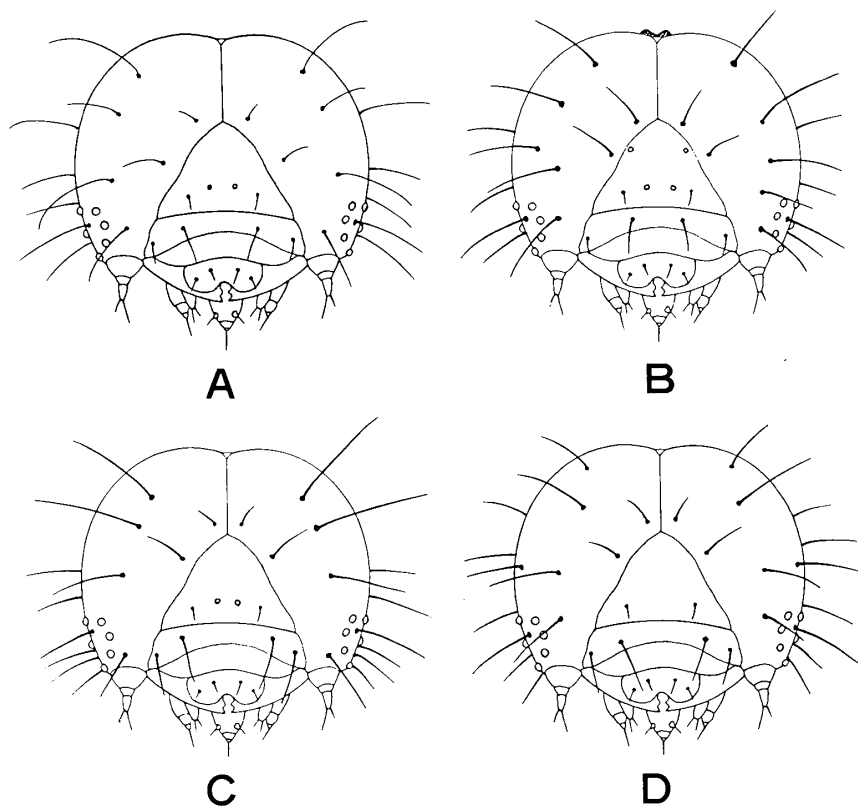
Fig. 4. Head chaetotaxies in first-instar papilionid larvae. A. *Bhutanitis lidderdalei*; B. *Parnalius cerisy*; C. *Luehdorfia japonica*; D. *Sericinus montela*.
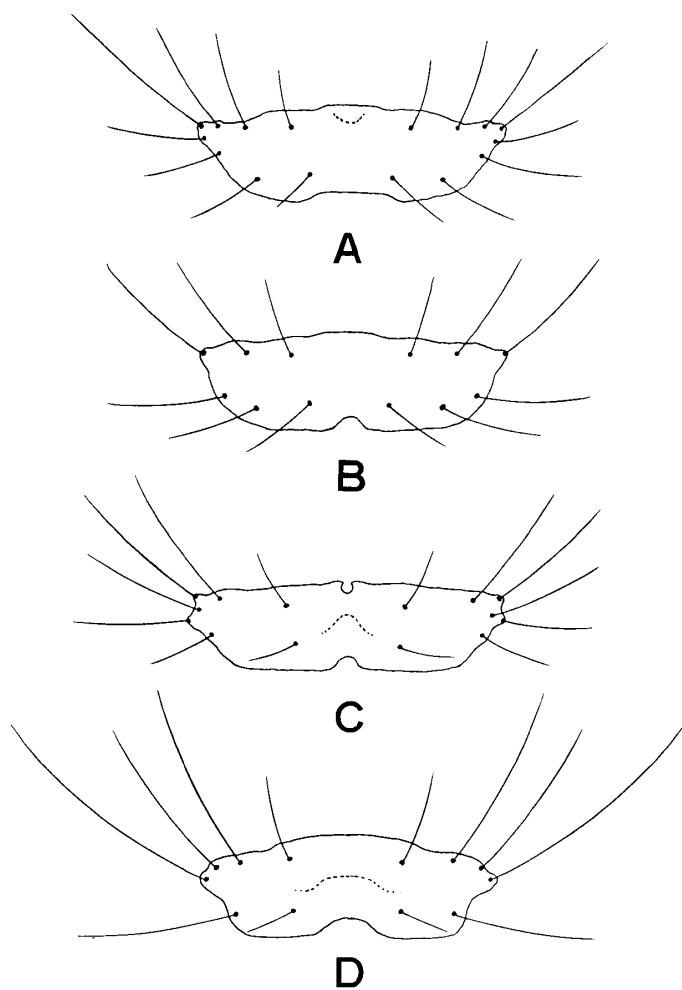
Fig. 5. Prothoracic shields in fisrt-instar papilionid larvae. A. *Bhutanitis lidderdalei* ; B. *Parnalius cerisy* ; C. *Sericinus montela* ; D. *Luehdorfia japonica*.
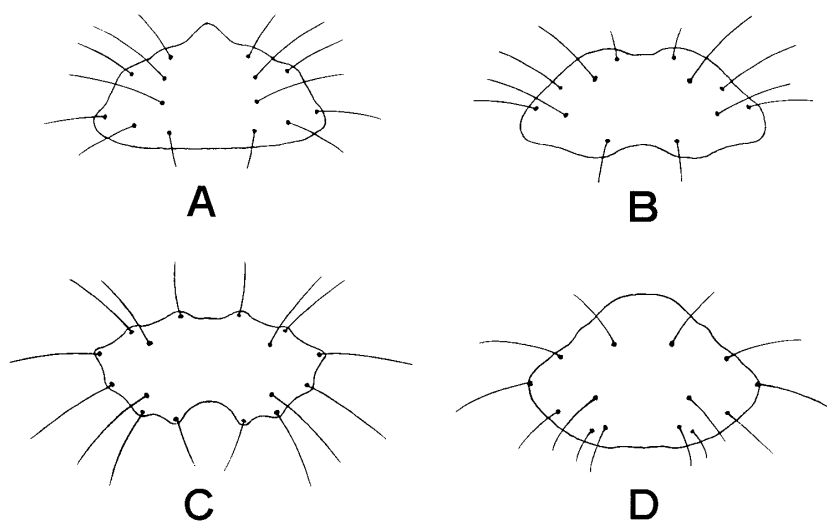
Fig. 6 Anal plates in first-instar papilionid larvae. A. *Bhutanitis lidderdalei* ; B. *Parnalius cerisy* ; C. *Luehdorfia japonica* ; D. *Sericinus montela*.
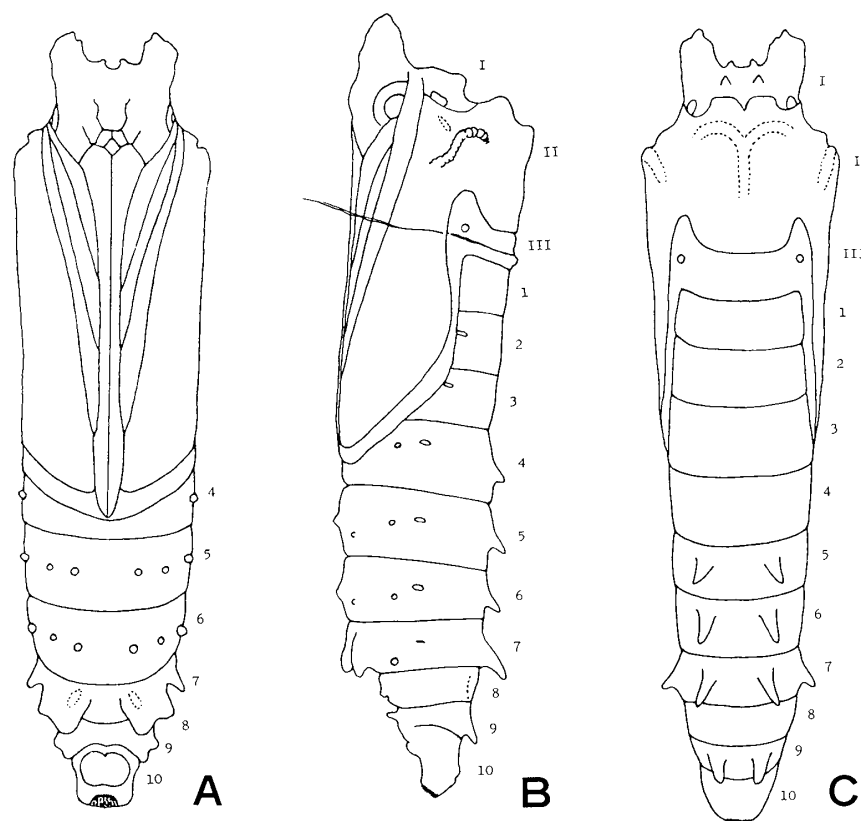
Fig. 7. Pupa of *Bhutanitis lidderdalei*. A. Ventral aspect; B. Lateral aspect; C. Dorsal aspect.

Discussion

Morphology of the early stages

Egg: No great difference is observed from those of other Zernthiini species, but lacks the pearly lustre of *Luehdorfia* or *Parnalius*. Also, the chorion is very much thicker.

First instar larva: The head chaetotaxy is of the most primitive type, similar to *Luehdorfia* and *Parnalius*. The prothoracic plate approximates that of *Parnalius*, but the number of setae on it differs. The arrangement and number of setae on the body closely resemble those of *Luehdorfia* and *Parnalius*, but not *Sericinus*.

These genera and *B. lidderdalei* greatly vary in the setal length: it is the longest in *Luehdorfia*, followed by *B. lidderdalei,* the shortest in *Parnalius*. The anal plate is similar to that in *Parnalius* and *Sericinus* but not *Luehdorfia*.

Second to fifth instar larvae: Despite minute differences, they resemble *Parnalius* but not *Luehdorfia*. The latter lacks fleshy tubercles or processes altogether, whereas *B. lidderdalei* is provided with some, which increase in size and length as the larva grows. This is also the case with *Parnalius* and *Sericinus*.

Pupa: The cylindrical body bears some resemblance to the pupal features of *Parnalius* which, however, has unique head crochets that take on the initially thoracic

girdle. *B. lidderdalei* has a normal girdle-type pupa. In appearance it suggests a *Chilasa* pupa, but lacks the latter's distinct ventral concavity with which it tightly contacts a twig. It has nothing at all in common with *Luehdorfia* as far as the body morphology concerned. The exposed lengths of the fore and mid legs in the five named genera are as follows:

Bhutanitis fore legs < mid legs
Parnalius fore legs < mid legs
Luehdorfia fore legs > mid legs
Sericinus fore legs > mid legs
Chilasa (not specified — either case occurs)

Conclusion

In view of the morphological features of its early stages, *Bhutanitis lidderdalei* is the closest to *Parnalius* among the Zerynthiinii. This is in complete agreement with the opinion of SAIGUSA (1983) based on adult morphology.

In addition, comparison between the author's material and the photographs of *B. thaidina* and *B. mansfieldi* published by LEE (1986a, b) has convinced the author that the above phylogenetic consideration applies to the whole genus of *Bhutanitis* rather than the single species *B. lidderdalei*.

References

ACKERY, P. R., 1975. A guide to the genera and species of Parnassiinae (Lepidoptera: Papilionidae). *Bull. Brit. Mus.* (*nat. Hist.*), **31**: 73–106.

BRYK, F., 1934. Lepidoptera, Baroniidae, Teinopalpidae, Parnassiidae, Pars I. Tierreich, 64: xxii + 131 pp.

FORD, E. B., 1944. Studies on the chemistry of pigments in the Lepidoptera with reference to their bearing on systematics. 3. The red pigments of Papilionidae. *Proc. R. Soc. London* (*A*), **19.** 4. The classification of the Papilionidae. *Trans. R. ent. Soc. London,* **94**: 201–223.

HIURA, I., 1980. A phylogeny of the genera of Parnassiinae on analysis of wing pattern, with description of a new genus [Lepidoptera: Papilionidae]. *Bull. Osaka Mus. nat. Hist.,* **33**: 71–95. (In Japanese.)

IGARASHI, S., 1979. Papilionidae and their early stages. Vols. 1, 2. Tokyo.

IGARASHI, S., 1984. The classification of the Papilionidae mainly based on the morphology of their immature stages. *Tyô to Ga,* **34**: 41–96.

LEE, C., 1986a. The life histories and phylogenetic positions of two Chinese species of *Bhutanitis* (Papilionidae) 1, 2. *Gekkan-Mushi,* **187**: 2–5, **188**: 2–7.

LEE, C., 1986b. First report on the life histories and phylogenetic positions of two Chinese Papilionid species, *Bhutanitis mansfieldi* and *B. thaidina* (summary of lecture), *Yadoriga,* **126**: 17–21. (In Japanese.)

MUNROE, E., 1960. The classification of the Papilionidae (Lepidoptera). *Can. Ent. Suppl.,* **17**: 1–51.

SAIGUSA, T. and LEE C., 1982. A rare Papilionid butterfly *Bhutanitis mansfieldi* (Riley), its rediscovery, new subspecies and phylogenetic position. *Tyô to Ga,* **33**: 1–24.

SAIGUSA, T., 1983. *Bhutanitis mansfieldi*: no longer a hypothetical missing link. *Chô Chô,* **6** (11): 1–56. (In Japanese.)

SHIRÔZU, T., 1955. A study on foodplants of the Papilionidae in relation to evolution. (In Japanese.) *Shin Konchu*, 8 (4) : 38－45, (5) 38－44, (7) 28－36.
TALBOT, G., 1936. Fauna of British India, Butterflies 1 (Ed. 2) : 1－300. London.

摘　　要

ブータンにおけるシボリアゲハの生活史（五十嵐　邁）

序　　文

シボリアゲハ*Bhutanitis Lidderdalei* ATKINSONは1868年ブータンのBuxa付近（6,000 feet）において Dr. R. LIDDERDALEにより発見された．本種は美しい大型の蝶であるばかりでなくその分類学的位置についても不明の点が多かったため当時から多くの研究者の興味をそそったので，かなり詳しい観察や記録も少くない．しかし産地がいずれも訪れることの難しい奥地の高標高の地なので生活史の解明には成功せず118年が過ぎた．その間，わずかにTYTLER（1912）がNaga Hillsにおいて採集した2♀が卵を産んだという記録が残されている．卵は黄色であって，蝶の大きさからすると非常に小さいと記されている．

筆者は1986，87年の2回にわたりブータンを訪れ，本種の生活史の一部を解明することができたので，着色図をそえてここに発表する．筆者が本種の採卵を行ったのは1986年秋であるが，その前年の春，中国において李伝隆 (1986a, b) によりシナシボリアゲハ*Bhutanitis thaidina* BLANCHARDおよびウンナンシボリアゲハ*Bhutanitis mansfieldi* RILEYの飼育がなされた．Zerynthiiniの中で最後まで生活史の判明しなかった属*Bhutanitis* 4種のうち3種がこうしてヴェールを脱いでくれたことは，アゲハチョウの系統分類学の発展にとって喜ばしいことである．李氏の功積を特筆して讃えたい．

発表にあたり日頃ご指導を賜わる日本鱗翅学会名誉会長白水隆博士，日本鱗翅学会会長緒方正美博士，日本鱗翅学会評議員黒沢良彦博士，京都大学教授日高敏隆博士，南山大学教授阿江茂博士，九州大学教授三枝豊平氏，T. G. HOWARTH，C. G. C. DICKSON，食餌植物の同定の労をとられた元東京大学名誉教授故原寛博士，東京大学黒沢幸子博士の諸氏に深甚な謝意を表する．

また探索の実施面においては原田基弘，松香宏隆，郡司芳明，原啓一，横倉明の諸氏の多大なご協力をいただき，久保快哉，柏原精一の両氏のご支援をも受けた．厚くお礼を申し上げる．探索に同行協力した妻昌子の労をも多とする．

生　　活　　史

1．産　　地

本種の分布はブータン，北インド（Chin Hills, Naga Hills），ビルマ，タイおよび中国西部にまたがる．どの地域においてもその産地は2,000 m前後の高標高の山岳地帯の狭い範囲に限られている．筆者が観察したブータン西部における産地Chasilakha付近においても，成虫は道路沿いの長さ約2 kmの範囲で観察された．道路の両側は垂直に近い絶壁なので，垂直分布は調査できなかった．産地は深い常緑樹林に覆われていて，食草もその範囲内で発見されている．この範囲をはずれると蝶はにわかに個体数を減じ稀となる．

2．成虫の生態

♂♀ともに晴天よりも曇天を好み，雨中をもいとわずに飛翔する．飛び方は緩慢で，崖ぎわに生える樹木の高い梢を徘徊するものがもっとも多く見られた．樹梢高く飛ぶのは主として♂であって，♀はあまり高所を飛ばない．♂♀ともに後翅をほとんど動かさずに尾をひくように飛ぶ姿は*Byasa*属に似る．障害物のない空間を活発に飛ぶ時は規則的に上下動しながら前進する．また静止中の1匹が飛び立つと，あちらこちらに

静止していた個体がいっせいに飛び立つ習性がある.♂♀ともにセリ科,タデ科などの房をなす白色小形の花を好んで訪れる.タイ北部では吸水行動が知られるが,ブータンでは観察例がない.

活動時刻は主として午前10時頃から午後5時前後で,時として午後6時近くにも観察される.成虫の活動が見られる通常の温度は20℃前後であって,16℃以下になるとまったく活動を停止する.

本種がアサギマダラ*Parantica sita*に似て見えることは古くDOHERTY (1891) が指摘しているが,発生期の終り頃になると多くの個体は翅の色彩が褪せて淡色となるので,飛翔中のものが似て見えるというのは事実である.とくに両種とも飛翔中に上下動をするので,さらに見誤りやすい.DOHERTYはまた本種の飛翔がオオゴマダラ属*Hestia* (現在は*Idea*が採用されている) に似ていると述べているが,筆者はブータンにおける本種の産地でオオゴマダラ属を目撃したことは一度もない.彼は本種が死後数日間にわたりよい香りを発すると記しているが,著者にはまったく感じられなかった.

3.発生回数

ブータン西部のChasilakha付近での観察によれば,成虫は♂が8月下旬より発生し9月上旬が最盛期,♀は9月中旬より姿を見せて9月下旬が産卵期と考えられる.そして10月上旬にもなお♂の求愛行動や♀の産卵行動が見られたところから,本種の活動は10月中旬まで続くものと想像される (Fig. 1).

春期に目撃,採集された記録や情報はなく,筆者自身の調査によってもまったく得られなかったところから発生は年1回,秋期に限られるものと考えられる.インド北部のNaga Hillsにおいても,タイ北部のChiang Daoにおいても同様である.

4.求愛行動

1986年9月中旬から10月上旬にかけて数回にわたり,一見結合したように見えた1対の♂♀が高い樹梢から落下してきた.最初筆者はこれらの♂♀は交尾中のものと考えたが,意外なことに彼らは着地するとすぐに離れて飛び去った。その後このような例を幾つか詳しく観察したところ,これらの♂♀は交尾が成立していず,♂は単に♀の背面に乗っていたのにすぎないことが判った.つまり♂の求愛に対して,すでに交尾ずみの♀が拒否をしたにもかかわらず,♂が執拗に♀をとらえて放さないのでこのような現象を生じたものとわかった.筆者はいまだ他の種類の蝶について,このような習性をこれほどの頻度で観察したことがない.正常な求愛行動については観察の機会に恵まれていない.

5.交　尾

1985年9月に交尾中の飛翔を1回目撃しているが,アゲハチョウ科の他の種と変りがなかった.すなわち♀主導型で,♂を吊下げて飛んでいた.

6.人工採卵

1985年9月中旬に捕えた4♀をPhuntsoling (400 m) において人工的に採卵を試みた。すなわちビニール袋に1頭ずつ♀を入れ,採集地に自生していた*Aristolochia griffithii* (Fig. 2,当時本種が自然状態における食草であることは知らなかった)を与えた.室温は約26~29℃であった.照明は40ワットの蛍光灯に袋が触れているものから,60ワットの白熱電球から3メートルほど離れたかなり暗いものまでまちまちであった.♀は与えられた植物に対してまもなく反応を示し,産卵を開始した.すなわち,食草の葉の縁につかまって腹部をゆっくりとU字型に曲げ,葉の裏面をpapillae analesの先端でこすり,1卵を産みつける.1卵を産むのに約20秒を要する.この行動をくり返して,20~40個の卵群を形成する.尾端がすでに産付した卵に触れると位置を変えて産む.産卵中に多少の刺激を加えても中止することはない.

これらの卵は同年9月25日に日本へ持ち帰られたが,1卵も孵化しなかった.卵を保存したPhuntsolingの気温が高く,カビが生じやすかったことが失敗の原因であったと考えられた.

翌1986年9月中旬に捕えた5♀を前年と同じ方法で採卵した．今回は卵をこれらの♀の採集地点Chasilakha（1,990 m）において布袋に入れて木蔭に吊るすことによって良好な結果が得られた．

7．産卵行動

自然状態における産卵行動は観察されていないが，産卵直前の行動は1986年9月下旬から10月上旬にかけて数回にわたり目撃された．すなわち♀は食草の低い位置の葉にとまり，羽ばたきながら前脚で葉の表面を叩く。卵塊をつくる蝶の習性として，産付植物の選択にはきわめて慎重で容易に産もうとはせず，結局産卵を行わずに飛び去った。これらの食草はいずれも道路に近く，環境が明るすぎたことが後に自然状態の卵を発見してから判った．同年9月30日，生息地の南端に位置するほとんど陽光の射さない暗い樹林の林床の下草として生えていた*Aristolochia griffithii*の地上約50 cmの位置の葉の裏面から18個からなる卵塊が発見された．つづいて同じ株の地上約30 cmの位置から36個，付近の他の株の地上20 cmの位置から10卵からなる卵塊が得られた．10月4日，同様な環境の食草の地上15 cmの位置から41の卵からなる卵塊が発見された．これにより♀は暗い樹林内の食草のきわめて低い位置の葉を選んで産卵することが判明した．中，高位置の葉および通風や日当りのよい場所からはまったく発見されなかった．これらの事実は他のタイスアゲハ族Zerynthiiniの産卵習性と一致する．

8．食　　草

Aristolochia griffithii 1種だけが確認された．本種の生息地からは他のウマノスズクサ科植物は発見されていない．飼育中の幼虫にオオバウマノスズクサ*A. kaempferi*（日本産），チョウセンウマノスズクサ*A. mandshuriensis*（韓国産），タイワンウマノスズクサ*A. shimadai*（台湾産）を与えたところ摂食した．しかしウマノスズクサ*A. debilis*（日本産），マルバウマノスズクサ*A. contorta*（日本産），*A. clematitis*（フランス産）は与えても食べなかった．

従来Zerynthiiniは葉の小さくて毛の少い*debilis*系のものは食べるが，葉が大きくても毛を生じる*kaempferi*系のものは受け容れないことが知られていた．しかし本種が*kaempferi*系の*griffithii*を食べることは，中国で発見されたシナシボリアゲハ*Bhutanitis thaidina*(李伝隆，1985)が同じく*kaempferi*系の*A. moupinensis*を食べることと一致して興味深い．

9．幼生期の生態

卵：今回の本種の卵期間は30日前後であった．現在までに知られるアゲハチョウ科の卵期はウスバシロチョウ属*Parnassius*がもっとも長く約10か月であって，本種はこれにつぐ．筆者が1986年9月29日に人工産卵させたものを10月5日まで原産地の野外に保存，その後日本において19～21℃に保存した結果11月2日に孵化した．原産地の10月後半の気温はさらに低いものと考えられるので，自然状態における卵期はこれよりも若干長いものと想像される．

幼虫：10月中旬から11月中旬にかけて孵化した幼虫は各種の条件下で飼育が試みられた．

1）22～25℃の室内飼育した個体は大部分が12月中旬までに死亡した．

2）少数の個体を昼間12℃，夜間6℃で飼育したところ，翌年2月27日，4月4日にそれぞれ1個体が蛹化した．これらは5月より22℃に保ったところ，8月にいたり体内に成虫化が確認されたが，羽化にはいたらなかった．

3）温度コントロールのない室内で飼育したところ，12月末から翌年1月上旬にかけて蛹化．4月14日，5月4日，5月19日にそれぞれ1♂が羽化し，残りの3匹は夏期に死亡し，そのうち1匹は成虫化がすすんでいた．

4）日本の冬期の自然状態と同じ温度で飼育したところ，4齢に達したもの少数をのぞき大部分は3齢で越冬した．

原産地の冬は寒さがきびしく11月から降霜，12月には降雪が見られると聞くが，本種の産卵場所が深い樹林内であったことを考えると，直接の霜や雪の影響は少く，この飼育方法がもっとも自然に近いものと思われた．したがって原産地においてもおそらく幼虫態で越冬するものと想像される．

幼虫は冬の間，食草の葉の裏面に静止して少量ずつの摂食を続けた．2，3匹が体を寄せ合うこともあれば単独で生息するものもあった．むしろ越冬中は群居性はあまり重要な意味をもたないものと考えられる．越冬中の摂食量は生命を維持する限界程度のもので，この間における幼虫の成長は認められなかった．

幼虫はきびしい寒さに耐える力が強く，健康に摂食を続けて春を迎えた．食草*Aristolochia griffithii*は冬期にも落葉せず，翌春4月に若葉を生じる．幼虫は旺盛にこれを摂食して5月上旬に蛹化した．これらの蛹から春期に羽化したものは皆無であった．蛹は室内に保存したところ，8月にいたって成虫化が認められたが，羽化には成功しなかった．

本種の年1回秋期の発生を決定する要因はおそらく幼虫越冬に存在するものと考えられる．

幼虫は各齢とも群居性が強く，食草の葉の裏面に体を接して静止する．しかし齢を重ねるにしたがって分散し，終齢になると2匹あるいは単独となる．*Pachliopta, Atrophaneura*などは食草の葉柄や茎をかじる習性があるが，本種にはその習性がない．蛹化は帯蛹形式をとる．地面に落葉を敷き，枯枝を立てた飼育箱内では，地上30 cm以下の低い位置で蛹化したが，李(1985)のシナシボリアゲハのように落葉内で蛹化するものはなかった．自然における蛹化位置などについては観察の機会に恵まれなかった．

形　　態

卵：やや偏平な球形で，頂部には識別が難しいほど微小な低突起がある．底部は浅い曲面をなして凹んでいる．色は淡い黄橙色で，産付直後は橙色味が強いがまもなく褪せて淡黄色に変る．直径は約1.37 mm，高さは約1.07 mm．

1齢幼虫：頭部は黒褐色で光沢があり，黒色の毛を生じる．毛の本数および配列はZerynthiiniの他の種と同じく最原始型である．頭幅は約0.90 mm．肉角は短く黄橙色．前胸背板は黒褐色で光沢があり，左右7対の長い黒色毛を生じる．胴部の体色は暗紫灰色で，背線両側には1対の灰色の帯が前胸から第9腹節まで縦走する．中胸から第9腹節にかけての亜背線上には各節1個の低い瘤状突起があり，中胸，第2，3，7，8腹節上のものは橙色，他のものは白色を呈する．各突起の先端には1本の長い黒色毛を生じる．前胸から第8腹節の気門下線上には各節1個の低い白色瘤状突起があり，1，2本の黒色毛を生じる．肛上板は黒褐色で光沢があり，7対の黒色毛を生じる．胸脚は黒褐色で光沢があり，腹脚および尾脚は体と同じ暗紫灰色である．

2齢幼虫：頭部は黒褐色で光沢があり，黒色毛を生じる．頭幅は1.31～1.44 mm．体の各部の突起は1齢期にくらべていちじるしく長大となる．突起の色や胴部の体色は1齢期と変わらないが，突起の先端に生じる1本の長毛は無色となる．

3齢幼虫：頭幅は1.97～2.48 mm．体の各部の突起は2齢期にくらべてさらに長大となり，橙色味を増す．とくに気門下線および基線上の突起までが橙色をおびるのは3齢期の特徴といえよう．

4齢幼虫：頭幅は2.98～3.20 mm．体の各部の突起は3齢期にくらべてより長大となるが，第2，3，7，8腹節上の橙色の突起の色は淡くなり，淡黄色に変わる．

終齢幼虫：頭幅は約4.70 mm．突起を含め体の形は4齢期と大差ない．第2，3，7，8腹節上の橙色突起は4齢期よりもさらに淡く，白色突起と区別がつかなくなる．基線上の突起は逆に濃い橙色に変わる．

蛹：体の概形は円筒形であって，頭部から前胸にかけての背面はこの円筒を斜に切ったようにほぼ平らである．体は褐色で微小な凹みが散在しその形ともあいまって枯枝に似た外観を呈する．頭頂部には1対の偏平な灰白色の突起があり，その他前胸に1対，中胸に2対の小突起をもつ．腹面では口吻先端は第4腹節後縁に達せず，そのわずか前方に終る．前胸部は露出するが中脚は途中から触角の下に埋没してふたたび露出しない．第1～4腹節背面には顕著な白色の太い帯状紋が縦走する．第4，5，6，7，9腹節亜背線上

には後方に傾いた1本の突起がある．第5，6腹節背面の突起に挟まれた部分には各1個の梯型の白色紋がある．第7腹節背面は全域白色，第8腹節から尾端にかけては側面，腹面も白い．第7腹節腹面には先端が2つに分かれた太い突起1対がある．胸部および尾端にかける懸垂用帯糸は黒褐色を呈する．体長は約34 mm.

幼生期の形態から見た本種の分類学的位置

卵：Zerynthiiniの他種との間に外見上の差異はほとんど認められないが，*Luehdorfia*や*Parnalius*に見られるような，表面の真珠色光沢は本種にない．またこれら2属に較べて卵殻がいちじるしく厚い．

1齢幼虫：頭部の刺毛配列は*Luehdorfia, Parnalius, Sericinus*とほぼ同じ最原始型である．前胸背板の形は*Parnalius*にもっとも似るが毛の本数は異なる．胴部の刺毛配列および本数は*Luehdorfia, Parnalius*にもっとも近く，*Sericinus*には似ない．これら4属の刺毛の長さにはいちじるしい差があり，*Luehdorfia*はもっとも長く，本種がこれに次ぎ，*Parnalius*はもっとも短い．肛上板の形は*Parnalius, Sericinus*と似るが，*Luehdorfia*には似ない．

2～5齢幼虫：細部において若干の差異はあるが，全体的に*Parnalius*にもっとも近く，*Luehdorfia*とは異なる．すなわち，*Luehdorfia*には胴体各部に肉質突起を欠くが，本種には存在し，齢を重ねるにしたがって発達して長大となる．*Parnalius Sericinus*とはこの点において似る．

蛹：体の概形が円筒形である点が*Parnalius*と共通であるが，*Parnalis*は頭部に鉤状突起があって，蛹化の際にはこれによって帯糸に懸垂するが，本種は通常の帯蛹形式をとる．本種の体形は一見したところ*Chilasa*にも似るが，本種の腹部は*Chilasa*のように枝に巻きつくように凹んでいない．*Luehdorfia*とはまったく体形に共通性がない．前脚と中脚の現われる長さの比較は次のようである．

Bhutanitis	前脚 < 中脚
Parnalius	前脚 < 中脚
Luehdorfia	前脚 > 中脚
Sericinus	前脚 > 中脚
Chilasa	種によって両型が存在する．

結　論

以上述べてきた幼生期の形態におけるZerythiini内の他属との比較を見ると，本種は*Parnalius*にもっとも近縁であると言えよう．

この結論は三枝豊平（1983）が成虫の形態からすでに推論しているものと完全に合致する．

なお李伝隆（1986）による*Bhutanitis*の他の2種*thaidina*と*mansfieldi*の幼生期の写真を検討した結果，これら2種の幼生期形態は本種と酷似することが判明し，上記の結論は種*lidderdalei*だけにとどまらず，属*Bhutanitis*に適用されるものであることを付記したい．
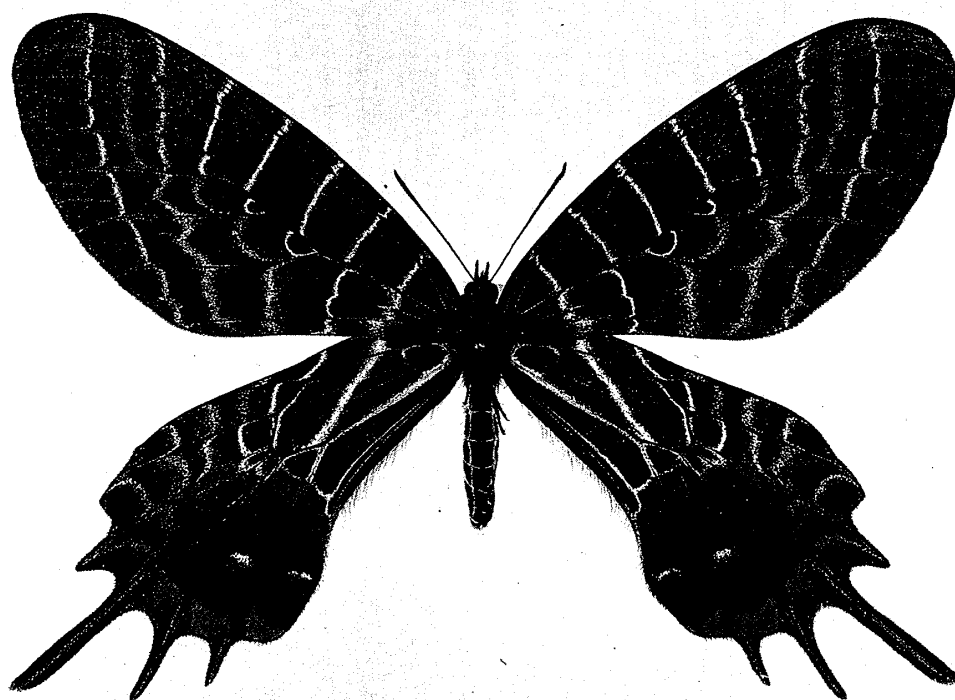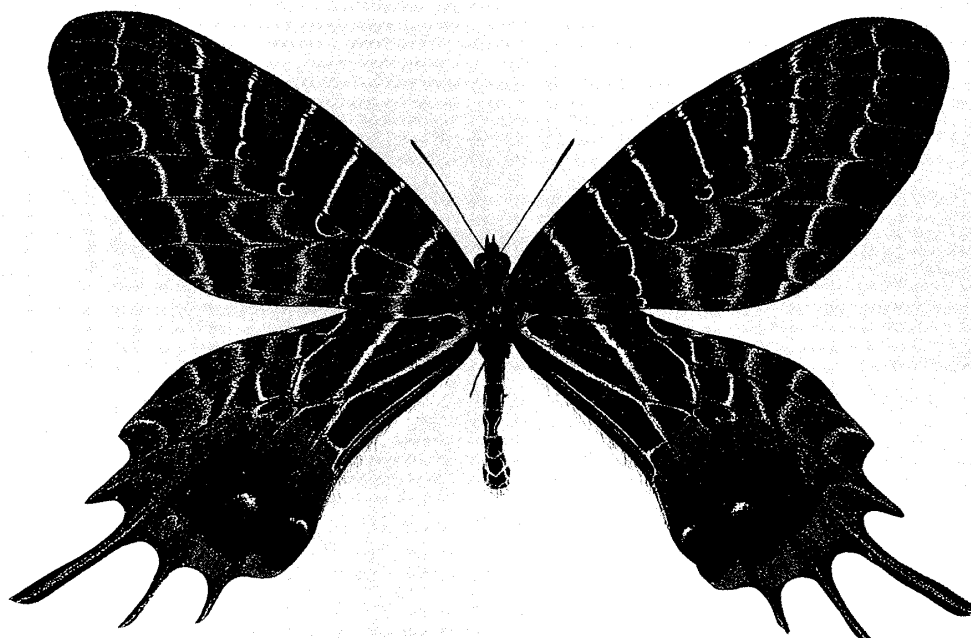
Plate 1. (×1.00)

Bhutanitis lidderdalei lidderdalei ATKINSON

Above: Male Chasilakha, BHUTAN. September 14, 1985

Below: Famale do September 15, 1985

Plate 2. *Bhutanitis lidderdalei lidderdalei* ATKINSON

0. Egg
1. First instar larva a) Dorsal and lateral aspects b) Head
   c) Osmeterium
2. Second instar larva Dorsal and lateral aspects
3. Third instar larva Dorsal and lateral aspects
4. Fourth instar larva Dorsal and lateral aspects
5. Fifth instar larva a) Dorsal and lateral aspects b) Head
   c) Osmeterium
6. Pupa Dorsal and lateral aspects

O
1a
2a
3a
4a
5a
1c
5c
1b
5b
P
S. Igarashi
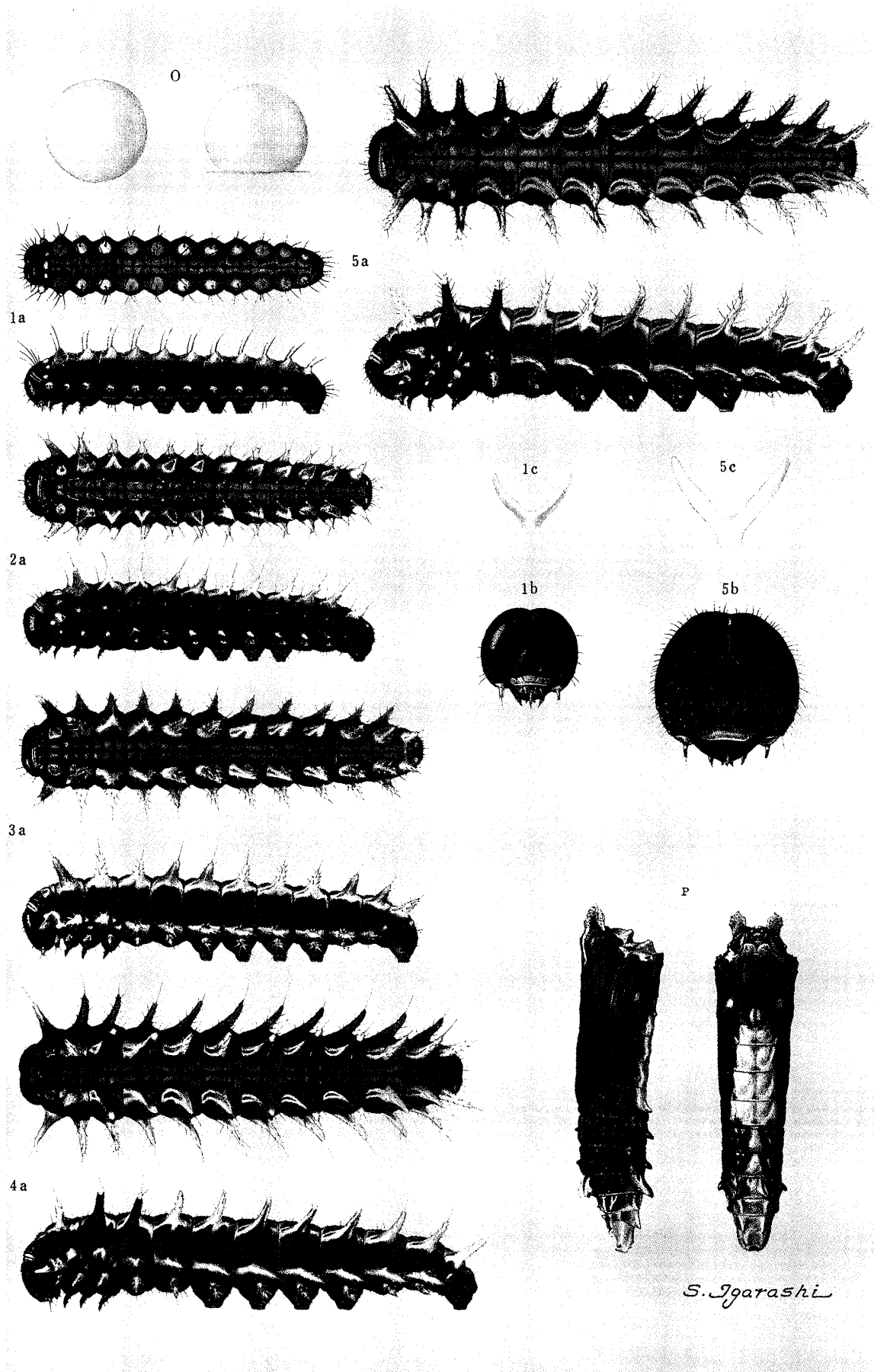
Plate 3. *Bhutanitis lidderdalei lidderdalei* ATKINSON

1. Female ovipositing in capitivity (Sept. 18, 1986)
2. Eggs laid captivity on the underside of a foodplant leaf (Sept. 20, 1986)
3. Eggs found in the field on *Aristolochia griffithii* (Sept. 30, 1986)
4. Gregarious 1st instar larvae (Oct., 1986)
5. Second instar larvae in small groups (Nov., 1986)
6. Pupa on dead twig (May, 1987)
7. Habitat near Chasilakha, Bhutan

1
2
3
4
5
6
7